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54 **Novel gel producing pad and improved method for surfacing and polishing lenses.**

57 A surfacing pad (10) is produced by dispersing abrasive particles (17) in a flexible, water absorbent matrix (16) that is secured on a flexible, fabric substrate (14), which functions as a reservoir for a liquid. By applying to the pad (10) a small quantity of liquid sufficient to wet the matrix (16) and to saturate the substrate (14), it is possible by rubbing the surfaces of a workpiece and the wetted matrix (16) to create an abrasive surfacing gel between the workpiece and the pad (10) substrate, thus eliminating the need for directing a slurry or other liquid onto the workpiece during a surfacing operation.

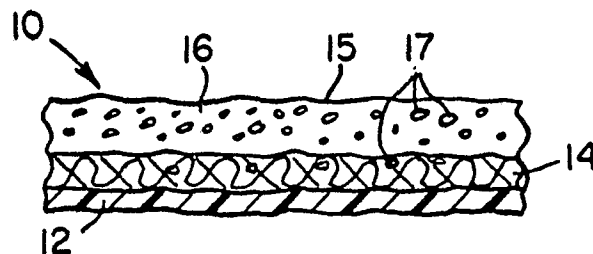


FIG. 2

EP 0 366 051 A1

NOVEL GEL PRODUCING PAD AND IMPROVED METHOD FOR SURFACING AND POLISHING LENSES

BACKGROUND OF THE INVENTION:

This invention relates to an improved method and product for surfacing and/or polishing lenses and the like. More particularly, this invention relates to a novel gel producing fining or polishing pad which considerably simplifies the process of fining and/or polishing lenses.

In general, the process for producing fine ground or polished surfaces on optical materials, such as for example on optical lenses, is much the same regardless of the type of fining or polishing medium employed, or the type of material being processed. In typical such operations, a fining or polishing pad is moved across the surface of the material to be processed, while either a slurry containing abrasive particles, or plain water, is directed in a stream between the pad and the surface to be processed.

One such prior art process is disclosed in U.S. patent No. 4,138,228, which teaches the use of a polishing pad having a water soluble, hydrophilic matrix containing unencapsulated abrasive particles that are rather weakly bonded to the matrix. This pad is used to conjunction with a constant stream of water, which assists in the release of polishing particles which are leached or torn from the pad matrix as the latter breaks down during use. In practice this pad has been found to be unsatisfactory because of the lack of contact between the released abrasive particles and the work.

U.S. patent No. 4,255,164 discloses a glass fining pad or sheet having a water insoluble, micro-cellular matrix containing abrasive fining particles. When the pad is used with an aqueous flow or stream its matrix breaks down and allegedly releases the fining particles at a controlled rate. While being effective for the grinding or fining stages of surfacing, this type of pad is not effective for polishing, even when using a polishing grade abrasive.

U.S. patent No. 4,576,612 discloses a polishing pad having a water soluble matrix containing polishing particles. A stream of water which is directed onto the interface between the pad and the work causes the exposed surface of the matrix slowly to dissolve thus slowly releasing polishing particles.

U.S. patent No. 3,042,509 also discloses a wax-like, polyethylene based polishing compound containing polishing particles, and adapted to be rubbed onto the surface of a buffing wheel or lap to provide both lubricating and polishing properties for the wheel or lap surface. The compound is water-soluble so that it can be washed off of the wheel

after the buffing operation.

Still other such prior art processes showing desirability of directing a slurry or other liquid in a stream to the interface between the work and a grinding or polishing pad are disclosed in U.S. patents No. 3,921,344; 3,959,935; 3,522,680; 3,225,497, 3,128,580 and 2,886,923.

None of the above-noted patents, however, discloses a pad designed to produce an abrasive gel upon being wetted. Moreover these prior art processes involve several problems, including the following:

A. It is difficult to keep the abrasive particles suspended in the liquid slurry or stream; or in other words, to prevent the settling out of the particles.

B. Large amounts of abrasive particles tend to stick to and to dry upon the processing equipment.

C. Frequent repair and replacement of pumps, which are used to circulate the abrasive slurry, are necessary.

D. It is extremely difficult to mix and control the concentration of the abrasive slurry.

One object of this invention, therefore, is to provide an improved fining or polishing process which eliminates the need for directing a stream of water or liquid slurry onto the work, thereby circumventing many of the problems associated with the previously mentioned process.

To this end it is an object also to provide a novel fining or polishing pad which in the presence of a small amount of water forms a very viscous gel, which adheres both to both the object being polished and to the pad substrate.

Still another object is to provide a novel water absorbent or adsorbent pad which, when wetted, makes all of its brasive material instantly available for fining or polishing.

A further object of this invention is to provide a novel pad of the type described having an abrasive-containing matrix made from a polymer which can absorb and retain large amounts of water to enable formation of a long lasting gel.

Still another other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims, particularly when read in conjunction with the accompanying drawing.

SUMMARY OF THE INVENTION:

The hereinafter described pad provides a disposable, self-contained article for fining or polishing the surfaces of various materials (plastics, metals,

glass, ceramics, etc.) using only a small amount of a liquid agent to produce between the pad and the work a gel which contains abrasive particles (fining or polishing). The abrasive particles (aluminum oxide, cerium oxide, etc.) are dispersed in a water absorbent or adsorbent, gel-producing carrier or matrix, which is coated uniformly onto a flexible reinforcing substrate, such as for example a fabric of the type used for conventional polishing or finishing pads. An adhesive is applied to the back of the substrate, and the entire structure is cut to form a conventionally shaped, multi-petal pad. The pad is attached to a surfacing lap and its matrix and substrate are wetted with a small amount of liquid. The motion of the lap forms on the pad a gel, which acts like a viscous slurry to surface the associated workpiece.

The optimum abrasive carrier or matrix provides rapid gelation, uniform dispersion of surfacing agent, lubrication between the lap or other surfacing substrate and the object being fined or polished, and produces a viscous matrix which retains or prevents loss of the abrasive. The preferred, matrix-supporting substrate is a fabric capable of absorbing water to function as a reservoir for the gel produced during use. The replacement of a slurry with a gel producing matrix eliminates the need for preparing, storing, and disposing of liquid slurries. It also reduces machine maintenance and cleanup-time.

THE DRAWING

In the drawing:

Fig. 1 is a plan view of a gel producing fining or polishing pad made according to one embodiment of this invention;

Fig. 2 is an enlarged, fragmentary cross sectional view taken generally along line 2-2 in Fig. 1 looking in the direction of the arrows; and

Fig. 3 is a side elevational view of a conventional fining or polishing lap as it appears with the pad of Fig. 1 secured thereon.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Referring now to the drawing by numerals of reference, 10 denotes generally a gel producing surfacing pad having therein the usual radial slots 11, which lend to the pad the conventional appearance of a petal-shaped pad. Pad 10 comprises several parts, each of which is responsible for a distinct function. For example, 12 denotes the attachment layer - which, as noted hereinafter is used to attach the pad 10 to a lap or the like. This

layer 12 may be any adhesive well known to the industry, such as for example a PSA adhesive.

Numeral 14 denotes the substrate layer. This layer has several functions. It provides an intermediate supporting layer between the attachment layer 12 and the hereinafter described surfacing layer; it provides a pliable surface which keeps the hereinafter described abrasive particles in contact with the surface which is being polished or fined; it retains a small amount of abrasive particles in its structure; and in use it acts as a reservoir for the wetting liquid. Any number of synthetic or natural pliable sheet materials can be used for the substrate layer 14, including but not limited to cotton, felt, paper, and woven or non-woven synthetics. These materials can be a flocked form, or may be altered in other ways (perforated, embossed, etc.) to help them retain abrasive particles and the surfacing layer or particle carrier layer.

The surfacing or particle carrier layer is denoted at 15, and comprises, preferably, a water absorbent matrix 16 containing abrasive particles 17. Layer 15 is the key component of the gel producing abrasive pad, and as noted hereinafter usually is coated as a paste onto substrate 14 in the range of approximately 10 milligrams to more than 250 milligrams of paste per square centimeter of the substrate surface. When applied in this manner, part of the matrix 16 and its particles 17 penetrate to a certain extent into the fabric substrate (Fig. 2), particularly in those cases where layer 14 is flocked or felted. Layer 15 has multiple functions which should be balanced to produce a good quality surface in the shortest amount of time. For example, the abrasive particles 17 preferably have a Knoop hardness of greater than 1000, and are of a particle size distribution which allows for rapid stock removal with the least amount of scratches left on the surface. For use as a polishing pad the particles 17 preferably should have an average particle size of 0.1 to 10.0 micrometers or microns, and for fining pads a range of from 10.0 to 50.0 micrometers is recommended. Abrasives that can be used include, but are not limited to, cerium oxide, aluminum oxide, silica, etc.

The gelling agent or matrix 16, which forms a gel on contact with a liquid, provides a medium which holds the abrasive particles 17 in the presence of a liquid between the substrate 14 and the material being surfaced (not illustrated). The matrix 16 is capable of holding relatively large amounts of liquid, which takes on swarf from the abraded surface, provides lubrication between the pad and the object being surfaced, and can provide cooling to materials which are heat sensitive. Materials suitable for creating matrix 16 include cellulose based materials, clays, alumina-silicates, polymer silicas, and similar materials. Other additives can be used

in conjunction with the gelling agent to matrix 16, such as chemical polishing accelerators, coolants, oxidation inhibitors, etc.

Some typical examples of the invention are as follows:

EXAMPLE No. 1 - POLISHING PAD

Preparation of gel/abrasive matrix:

Part A)

20 grams of propylene glycol and 10 grams of a sodium carboxymethylcellulose carrier, such as for example the type known as CMC 7L and sold by Aqualon of Wilmington, Delaware, were mixed until well dispersed.

Part B)

160 gr. of water, plus 5 gr. of a dispersant known as Darvan 7, which is sold by Vanderbilt Co. of Norwalk Conn., and 150 gr. of aluminum oxide, having an average particle size of approximately 2.5 microns, were mixed until well dispersed.

Part B was then mixed into Part A until the mixture was a smooth paste. Ratio of abrasive (150 gr.) to dry carrier (10 gr.) was 15:1.

The mixture of parts A and B was then coated as a layer 15 onto a pad substrate 14 which comprised of a commercially available flocked polyester fabric such as 0.020 inch rayon flock sold by Tempo/Shane of Peabody Mass.

The layer 15 of paste was coated on substrate 14 to a thickness of approximately .005 - .008 inches. The fabric substrate 14 was then placed in an oven at 300° F. for five minutes. After cooling the fabric, a pressure sensitive adhesive layer 12 was attached to the back of layer 14, and pad 10 was cut to its desired shape using a steel rule die.

TESTING

Each of a first set of polishing pads made according to Example No. 1 was mounted on a lap 20 and saturated with about 20 ml. of water, enough to wet the matrix 16 and to saturate the reservoir layer or substrate 14. The lap was put on a Coburn 505 polishing machine set on low speed and at a pressure of at 20 psi. A fined plastic lens (Supremacy 65 form Coburn Optical Industries, Muskogee, OK.) was mounted and (polished) run

for three minutes for each pad.

A second set of pads was prepared and run using the same procedure, except that in preparing part A of Example No. 1, the amount of propylene glycol was increased to 40 grams, and each pad was not saturated with water.

A third set of pads was prepared and run using the same gel/abrasive matrix and polyester fabric as in the first set, but the uncoated pad fabric was first attached to the lap, after which 4 grams of paste was smeared onto each pad.

RESULTS: First Set of Pads

Number of tests : 10
Range of removal : 15 mg. to 31 mg.
Average removal : 25 mg.
Surface quality : Equal to current industry standards
Optical quality : Very Good

Second Set of Pads

Number of tests : 3
Range of removal : 10-21 mg.
Average removal : 14.3
Surface quality : Equal to low quality commercial lens.
Optical quality : Passable

Third Set of Pads

Number of tests : 1
Removal : 23 mg.
Surface quality : Equal to industry standard
Optical quality : Very good

EXAMPLE No. 2 - FINING

Preparation of gel/abrasive matrix:

Part A)

150 grams of Fine-Rite .025 Alumina, produced by Ferro Corp., Penn Yan, N.Y., plus 100 grams of deionized water, and 5 grams of Darvan 7, all of which were mixed until well dispersed.

Part B)

15 grams of carboxymethylcellulose (CMC 7L) plus 23 grams of propylene glycol were mixed until well dispersed. Part B was then mixed into Part A under agitation. Ratio of abrasive (150 gr.) to dry

carrier (15 gr.) was 10:1.

This mixture was coated as a layer 15 onto a .005 inch glass- polishing fabric substrate, which was the type sold by Pellon of Chelmsford, Ma., at thickness of .005 inches, and placed in a 300° F. oven until dry. The cooled material was laminated to a pressure sensitive adhesive layer 17 and a multi-petal pad was die-cut from this material.

TESTING

The fining pad of Example No. 2 was mounted on a lap 20 and saturated with about 20 milliliters of water. The lap was put on a Coburn 505 polishing machine set on low speed at a pressure of 20 psi. A plastic lens was mounted and run (fined) for two minutes by the pad of Example No. 2.

RESULTS: Finishing Pad

A) Number of tests : 1
Removal : 44 mg.
Surface quality : Very good.

EXAMPLE No. 3 - POLISHING

20 grams of alumina having an average particle size of approximately 2.5 microns was mixed with 8 grams of Clay Bentone SD-1 (NL Chemicals) and 25 grams of deionized water until well dispersed. Ratio of abrasive (20 gr.) to dry carrier (8 gr.) was 2.5:1.

TESTING

The paste was coated on a flocked polyester pad or substrate 14, which was then attached to a polishing lap. The lap was attached to a Coburn 505 polishing machine and run for three minutes on low speed at a pressure of 20 psi. A plastic lens was used.

RESULTS: Polishing Pad

A) Number of tests : 1
Removal : 21 milligrams
Surface quality : Equal to current industry standards
Optical quality : Very good

As used herein the term gel is intended to have its common meaning such as for example of substance which is a colloid in which the disbursed phase was combined with the continuous phase to produce a semisolid material, such as a jelly.

From the foregoing, it will be apparent that the present invention considerably simplifies the process and apparatus heretofore required to fine grind and/or to polish rigid surfaces, such as for example the surfaces of optical lenses. By using a special gel-producing pad, it is possible to eliminate the need for directing a stream of liquid slurry or water onto the interface between a pad and lens, for example, thus eliminating also the need for using recirculating pumps and/or filters for directing a slurry continuously onto the work during a surfacing operation. With the novel pad disclosed herein it is necessary only to wet the surface of the pad at the commencement of a surfacing operation, and possibly to squirt a supplemental amount of liquid onto the pad during prolonged surfacing operations. In any event, it is not necessary continuously to direct a stream of liquid onto the pad because of the gel-like coating formed thereon at the outset of the operation. To prevent the dry carrier or matrix forming material from diluting the cutting effect of the abrasive it is preferred that the ratio of abrasive to dry carrier be kept as high as possible.

Obviously pads of the type disclosed herein can be utilized to surface rigid products or work pieces other than optical lenses, for example in the lapidary and gem making art. Also, while other organic compounds could be used as gel producing matrices, such as for example polyvinyl alcohol, polyethylene glycol, alginates, gums, and combinations thereof, they are not quite as effective as the above-noted water absorbing or retaining materials such as cellulose based materials and the like. Also, in addition to fabric substrates such as denoted at 14, other flexible, water absorbing and retaining substrates could be employed without departing from this invention.

Moreover, although this invention has been illustrated and described in detail in connection with only certain embodiments thereof, it will be apparent that it is capable of still further modification, and that this application is intended to cover any such further modifications as well as those that fall within the scope of the appended claims.

Claims

1. An abrasive surfacing article, comprising a flexible substrate, a flexible matrix layer coated on the surface of said substrate, and plurality of abrasive particles dispersed throughout said matrix layer, and characterized by the fact that said matrix layer comprises a material selected from the group consisting essentially of cellulose based materials, clays and silicas, and which is operative upon being wetted with a liquid to produce a gel that

holds said particles in the presence of said liquid, and said substrate comprises a water-absorbent material operative to function as a reservoir for the liquid which is used to wet said matrix layer.

2. An abrasive surfacing article as defined in claim 1, wherein said group consists further of gums, polyvinyl alcohol, polyethylene glycol, alginates, and combinations thereof. 5

3. An abrasive surfacing article as defined in claim 1 or 2, wherein said abrasive particles have a Knoop hardness of at least 1000, and an average particle size in the range of about 0.1 to 50.0 micrometers. 10

4. An abrasive surfacing article as defined in any one of claims 1 to 3, wherein said substrate is made of an absorbent fabric. 15

5. An abrasive surfacing article as defined in any of the preceding claims, wherein the weight ratio of said abrasive particles to said material comprising said matrix layer falls in the range of approximately 2.5:1 to 15:1. 20

6. A method of preparing an optical quality surface on a workpiece, comprising providing a surfacing pad having a liquid absorbent, flexible substrate coated with a flexible matrix having a plurality of abrasive particles dispersed therein, applying a liquid to said matrix and said substrate, and rubbing the surfaces of said workpiece and said matrix, respectively, one relative to the other, and characterized by the fact that said matrix comprises a material capable of producing a gel, when wetted, and said liquid is applied to said pad in a quantity only sufficient to saturate said substrate and to create an abrasive surfacing gel between said workpiece and said pad substrate. 25 30 35

7. The method as defined in claim 6, including applying said liquid to said pad prior to commencement of rubbing said one surface relative to the other, and completing the surfacing of said workpiece without applying any additional liquid to said pad. 40

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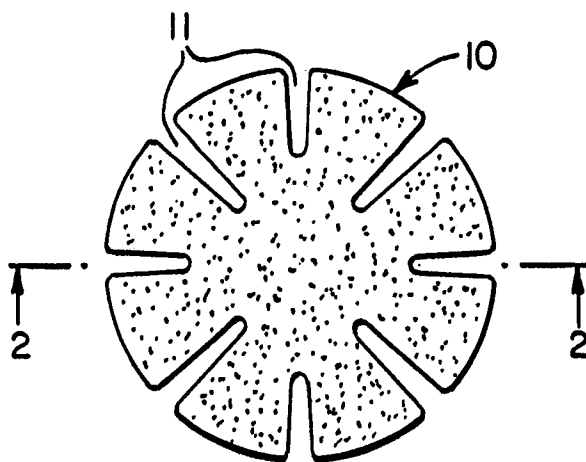


FIG. 1

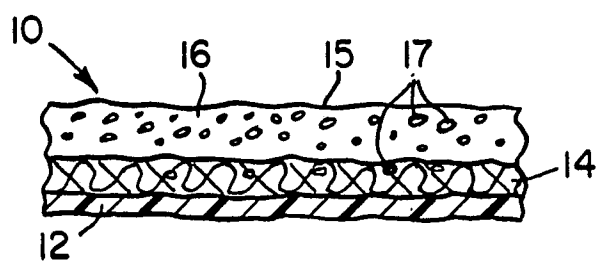


FIG. 2

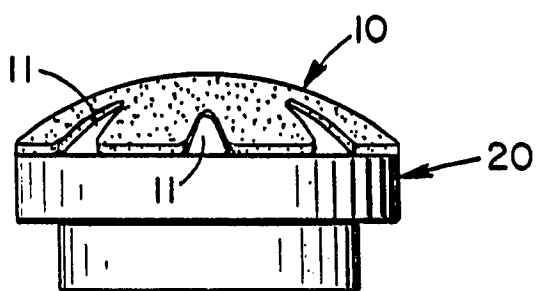


FIG. 3



DOCUMENTS CONSIDERED TO BE RELEVANT			EP 89119666.9
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.) 5
A	<u>EP - A2 - 0 192 047</u> (INTERNATIONAL BUSINESS MACHINES) * Claims 1,2,12; page 7, lines 19-26 * --	1,2,5	B 24 D 3/20
A	<u>EP - A2 - 0 211 591</u> (MINNESOTA MINING) * Claims 1,2; column 4, lines 7-11 * --	1,5	
D,A	<u>US - A - 4 576 612</u> (SHUKLA et al.) * Claims 1,2 * --	1,3	
D,A	<u>US - A - 4 255 164</u> (BUTZKE et al.) * Claim 1 * ----	1,2-5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.) 5 B 24 D
Place of search VIENNA		Date of completion of the search 10-01-1990	Examiner WILFLINGER
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			